Idle Reduction Technologies for Heavy Duty Trucks

Technology Introduction Plan

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Prepared for
Idaho National Engineering and Environmental Laboratory
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Office of FreedomCAR & Vehicle Technologies Program

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1.0 Abstract

Reducing idling in heavy duty trucks has been identified as a practical way to lower the Nation's dependence upon imported oil while decreasing harmful criteria pollutant emissions and greenhouse gases. The U.S. Department of Energy's Advanced Vehicle Testing Activity (AVTA) is undertaking activities to overcome barriers inhibiting the introduction and broad market acceptance of on-board idle reduction technologies. Data collected from the trucking industry and related stakeholders in 2002 and 2003 is presented with regards to industry's perspectives on the barriers, needs, and appropriate role of Government in encouraging the introduction and use of idle reduction technologies in heavy duty trucks. In particular, this technology introduction plan focuses on the need and implementation schedule for joint Government-industry data collection/demonstration, cost reduction, and education and outreach activities.

2.0 Introduction

It is estimated that 0.3 percent of all petroleum (~840 million gallons of diesel fuel annually) consumed in the United States is used by idling heavy duty trucks. Idle reduction technologies for heavy duty trucks have been available since the 1980s, and today various technologies are on the market including auxiliary power units, gensets, diesel fired heaters, cooling devices, and truck stop electrification systems. To date, however, no technology has achieved mainstream status largely as a result of economic, institutional, and to a lesser degree technical barriers. Today, only a very small percentage of heavy duty trucks are equipped with non automatic engine shutdown idle reduction technologies.

2.1 Data Collection and Workshop Results

In the later part of 2002, The Department of Energy's Advanced Vehicle Testing Activity (AVTA) undertook an extensive effort to better ascertain the issues surrounding the introduction and use of idle reduction technologies in heavy duty trucks. Four trucking industry stakeholder groups (fleets, owner-operators, truck OEMs, and idle reduction technology manufacturers) were contacted with regards to their perspectives on the barriers, needs, and appropriate Government role in encouraging the introduction and use of idle reduction technologies. Two workshops (one to characterize data collection/ demonstration parameters and the other to identify cost reduction strategies) were conducted in 2003 to further lay the foundation for a demonstration plan and the development of this technology introduction plan. Appendices A and B provide results of these workshops in raw, tabular form. The following provides a synopsis of information gleaned from the four trucking industry stakeholder groups.

Truck fleets and owner/operators indicate the strongest interest is for combined heating/cooling/electrical idle reduction systems with cooling or heating alone a distant second. Truck manufacturers have indicated there is a need for stronger interest/pull for idle reduction technologies from fleet customers. Overall, the primary barriers facing idle reduction technologies are cost, driver education/training/receptiveness, reliability and maintenance, and weight/size.

- Cost is by far the biggest barrier with fleets, owner-operators, and truck OEMs indicating payback periods should be no more than 2, 2 to 3, and 1-1/2 years, respectively. Economic savings are currently based only on reduced fuel use and utilize a simple break even payment method. Idle reduction systems can save approximately $1500-2000 per year in fuel costs. The principal barrier is the cost/payback period, which currently doesn't make a strong business case for fleets.
- Driver education/training/receptiveness is also a major barrier and efforts are needed to overcome resistance to new technologies, dispel misconceptions, and break ingrained idling habits.
- It is important for the reliability and service intervals of idle reduction technologies to match those of trucks—requiring service more frequently is a strong disincentive for fleets.
- Combined heating, cooling, and electrical systems weigh approximately 300-400 lbs and are in general perceived to be too large (volumetrically), which can be a barrier for some fleets especially bulk carriers.

Additional information provided by stakeholders relevant to the analysis of idle reduction technologies is as follows:

- In terms of the number of units sold, Freightliner and PACCAR (Peterbilt and Kenworth) are the biggest truck manufacturers followed by Volvo, while Caterpillar, Cummins and DDC (evenly) provide most of the truck engines. Each of these corporations participate in the 21st Century Truck Partnership.
- About half the fleets and only 17% of owner/operators track idling. On average, fleets and owner/operators idle about 2000 hours per year or between 20-39% of the time the engine is on.
- Economics is the principal reason for using idle reduction technologies with user reactions mixed—half good, half not so good.
- Industry trade publications are the principal source of information on trucks and related items such as idle reduction technologies.

3.0 Goal and Objectives

Reducing idling has been identified as a practical way to lower the Nation's dependence upon imported oil while minimizing harmful emissions. The U.S. Department of Energy's AVTA is undertaking activities to overcome critical barriers facing on-board idle reduction technologies and to increase market acceptance. The goal is shown in the box below.

Goal:

To maximize the introduction and use of idle reduction technologies in heavy duty trucks.

This technology introduction plan for idle reduction technologies has three primary objectives:

Objectives:

1. Data Collection/Demonstration
2. Cost Reduction
3. Education and Outreach

The intent of **Objective 1** is to gather objective in-use information on the performance of on-board idle reduction technologies by characterizing the cost; fuel, maintenance, accessory, and engine life savings; payback; and user impressions of various systems and techniques. Data collection and demonstrations are needed to provide information for fleets and owner-operators to make informed purchase decisions. Objective 1 will also establish a technology baseline that will allow the 21st Century Truck Partnership to determine R&D needed to achieve the overall idle reduction goals of the Partnership. The focus of **Objective 2** is to identify and implement strategies to overcome critical cost barriers inhibiting broad market introduction. The target is to achieve payback periods of two years or less which are consistent with the needs of potential users. **Objective 3** calls for conducting education and outreach to increase the knowledge, awareness, and acceptance of idle reduction technologies within the trucking industry and public at large.

4.0 Technology Introduction Plan

This section discusses strategies to overcome the critical barriers facing the introduction of idle reduction technologies for heavy duty trucks. Efforts by Government in several of these areas are key, most especially data collection and demonstration, cost reduction, and education and outreach. In several of these areas, it is feasible and appropriate for Government to play a role — even in a lead capacity. In others, it is clearly the responsibility of idle reduction technology manufacturers, truck OEMs, and/or fleets to assume the lead responsibility. Research and development of idle reduction technologies is also key and is being addressed under other DOE activities within the 21st Century Truck Partnership.

4.1 Data Collection/Demonstration

A major barrier facing idle reduction systems is the lack of broadly accepted, real world data collected by a non-biased third party on the cost/payback, performance, maintenance, and user impressions of idle reduction technologies. An attractive return on investment is key for heavy duty truck fleets to adopt idle reduction technologies. Data collection and demonstration activities should determine the differential between an idle reduction technology equipped truck and a standard truck leading to identification of payback time for idle reduction systems, as well as establishing a technology baseline for the 21st Century Truck Partnership. The ultimate objective is to accurately quantify savings via reduced fuel consumption and reduced maintenance expenses while subtracting the cost and time of maintenance for the idle reduction system.

Data collection should employ simple protocols utilizing information from the engine computer whenever possible. In this way, errors inherent with manual collection of data can be avoided. Long term evaluation is preferable and ideally testing should proceed for at least two full years to account for seasonal variations. Comparable and consistent testing methods should be used throughout demonstration projects. Heavy duty trucks travel over 100,000 miles per year on average and demonstration projects should strive to achieve this threshold.

A) ***Fuel Consumption:*** This is the most critical data to be collected. Despite past data collection efforts, there is still confusion within the trucking industry with regards to exactly how much fuel heavy duty trucks actually consume during idling, as well as how much fuel idle reduction technologies consume. It is essential to comprehensively and accurately measure fuel consumption in a consistent manner acceptable to the trucking industry. The percentage of time spent idling should be closely monitored both before and after installation of idle reduction technologies, including the number of hours the idle reduction equipment is operated. If possible, it is preferable that comparable routes are traveled for both idle reduction technology equipped and standard control vehicles.

B) ***Idle Reduction Technology Costs and Reliability/Durability:*** The purchase, installation, and maintenance costs of idle reduction technology are to be collected. Installation includes the costs to retrofit the technology and, if possible, an estimate of the cost if the technology was installed on line at a truck OEM.

Maintenance costs should track the reliability/durability of the system including regularly scheduled and unscheduled maintenance requirements. Truck downtime as a result of maintenance of idle reduction technologies should be closely tracked. It is essential to maintain good record keeping to fully illuminate maintenance issues. This also includes tracking failure costs of standard equipment on non idle reduction technology equipped trucks.

C) ***Engine and Accessories Wear and Maintenance:*** Idle reduction devices would extend the operating life of the truck's engine and it would be ideal to quantify benefits from reduced idling. However, trucks are typically turned over every four years or so and therefore fleets do not see the direct benefits of reduced engine wear in their cost calculations. To determine reduced engine wear, engine tear downs would typically have to be conducted at about 700,000 - 1 million miles and 2 million miles, long past the culmination of the demonstration programs. As such, it is not feasible to fully quantify the economic benefits of reduced engine wear within the framework of the proposed demonstration projects. In the future, however, reducing the number of engine operating hours is likely to increase the resale value of trucks and these values should be tracked.

   It is feasible, however, to quantify the benefits of reduced accessory wear and replacement (injectors, turbo-charger seals, battery life, alternator, etc.) through the use of idle reduction devices. Cost avoidance due to redundant systems can also be tracked (e.g., alternators). It may also be feasible to defer oil and filter changes and demonstration projects should accurately track and quantify these secondary benefits of reduced idling.

D) ***Driver Acceptance:*** In order for idle reduction technologies to make a significant market impact, they must be accepted not only by the fleet managers but the drivers as well. Data should be collected on driver acceptance of idle reduction technologies including drivers' perspectives on the reliability, features, comfort, and noise levels of the systems. Tracking idle time may provide good insight into driver acceptance as would tracking the number of overrides. Driver acceptance should be captured through a common data collection mechanism which is used by all demonstration project participants. In this way, nuances can be eliminated reducing the risks of skewing the results of what could be a subjective assessment. It is important to assess driver satisfaction in corresponding areas both before and after the demonstration in order to provide an appropriate baseline.

A relatively large body of data on idle reduction systems already exists and it may be advantageous to tap into it. The American Trucking Associations, certain truck fleets, and idle reduction technology manufacturers have collected considerable data over a number of years. For example, this data may be able to be used retroactively for examining engine wear.

It is also important to be judicious when publishing information resulting from data collection/demonstration projects. Depending upon operating conditions and other assumptions, information could be found to be misleading or skewed, and it is essential that only quantitative (not subjective) information be published.

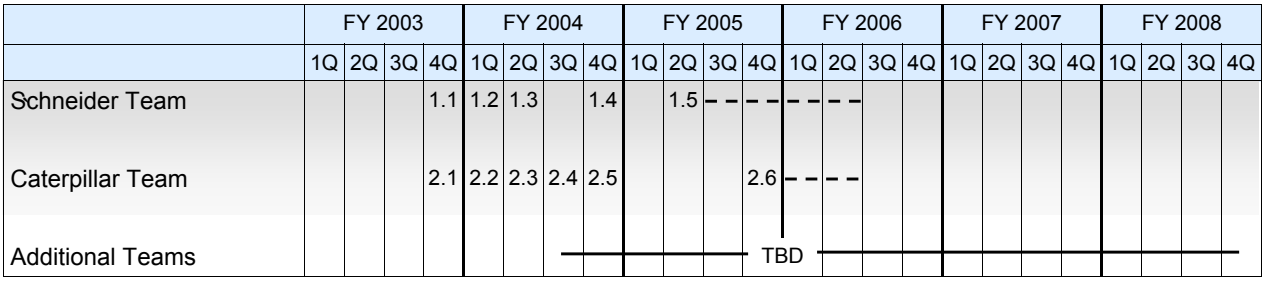
As a first step in demonstration and data collection, the DOE Advanced Vehicle Testing Activity has awarded two separate financial assistance awards to Caterpillar Inc. and Schneider National Inc. to investigate idle reduction technologies. Caterpillar's project, "Demonstration of the New MorElectric Technology as an Idle Reduction Solution," will apply electrically driven accessories for cab comfort during engine off stops as well as to reduce fuel consumption during normal truck operation. International Truck will equip five new trucks with the technology for operation by Cox Transfer.

Schneider's project, "Cab Heating and Cooling," will demonstrate the Webasto Cab Cooler that utilizes a phase change cooling storage technology to cool the truck cab during engine off conditions. Twenty Freightliner trucks will be equipped with the Cab Cooler, and 100 trucks will have a self-contained diesel fueled air heater installed to demonstrate engine off cab heating.

Both projects will strive to collect all of the data collection items defined in Table 1. These data were identified in the user workshops to be of most interest for determining the value of and business case for idle reduction technologies.

Figure 1 illustrates the implementation schedule for data collection/demonstration activities of the idle reduction technology projects. The teams led by Schneider International and Caterpillar will be conducting data collection/demonstration activities starting in FY03. The award of a third project is expected in FY04, and in the future, these specific demonstration projects may be extended if necessary to produce the required quality data.

Figure 1. Data Collection/Demonstration Implementation Schedule



1.1 Schneider project start
1.2 Install on-board heaters for cold weather evaluation
1.3 Report on first season of warm weather operation (cooling technology performance)
1.4 Report on cold weather operation (heating technology performance)
1.5 Final analysis and results report
2.1 Caterpillar project start
2.2 Retrofit prototype truck with HVAC system (Truck #0)
2.3 Order first truck from International (Truck #1)
2.4 Evaluate and debug Truck #1; Order remaining trucks
2.5 All ten trucks in service
2.6 Final analysis and results report

Table 1. Idle Reduction Technology Demonstration Data Items

Type of Data	Frequency Recorded	Data Items
IR Technology Specifications and Initial Costs		
IR System Descriptions	Start of data collection and changes as needed	Detailed description of installed system
IR System Capital Cost	Start of data collection and changes as needed	Total cost for IR system
IR System Installation Costs	Start of data collection and changes as needed	Cost of installation including: labor time and rate, and travel time to shop
Vehicle Operation		
Vehicle Operating Cycle	Start of data collection and changes as needed	General description of daily use of vehicles, more detailed information if available
IR System Usage in Service	Each time IR system is used	Start and stop time
		Purpose of idle time
Fuel Use at Idle	Start of data collection	Parasitic brake horsepower and engine RPM at various load combinations
Fuel Consumption	Each time a vehicle is fueled	Amount of fuel
		Odometer reading
		Date
	Each time the fuel price changes at a given site	Price per unit
Noise Level	Start of data collection	Standardized decibel measurements taken at various load conditions
Engine Oil Consumption, Analysis and Changes	Each time oil is added	Amount of oil
		Odometer reading
		Date
	At regular service intervals	Oil analysis
	Each time oil is changed as recommended by the engine manufacturer	Price per quart
		Amount of oil
		Odometer reading
		Date
Maintenance (include maintenance costs not only for IR technologies, but for items like injectors, turbo-charger seals, battery life, alternators, fan clutch, AC compressor, etc. that may be reduced due to the use of IR technologies)	For each work order	Type of maintenance: scheduled, unscheduled, road call, configuration change
		Labor hours
		Date of repair
		Number of days out of service
		Odometer reading
		Parts replaced
		Parts cost
		Description of reported problem
		Description of repair performed
		Typical data on maintenance costs for trucks that do not use IR technologies
Other Information Needed to Evaluate IR Technology		
Fuel consumption of the idle reduction device	Start of data collection	Amount of fuel (for various loads)
		Operation time (duty cycle)
Truck Emissions at Idle	Start of data collection	Record historical or engine manufacturer data
IR Technology Emissions	Start of data collection	Record data from technology OEM
Resale Value	End of demonstration	Value of vehicle
Driver Satisfaction	Quarterly and at end of demonstration	Record impressions and observations of driver

4.2 Cost Reduction

Cost is the single biggest barrier facing widespread implementation of idle reduction technologies in heavy duty trucks. Most fleets and owner operators demand no more than a 2-year payback period, while most idle reduction systems have payback periods of 3-4 years. For fleets, savings are currently based strictly on reduced fuel use where idle reduction systems can save approximately $1500-2000 per year in fuel costs. Typical combined heating, cooling, and electrical systems cost approximately $6000-8000 installed. As such, it is projected there is a need to drive down the cost of purchasing and installing idle reduction systems by approximately $3000-4000. This figure may change depending upon potential savings that could be achieved through reduced engine oil changes, less frequent replacement of ancillary equipment, resale value, and the price of diesel fuel.

Currently, most idle reduction systems, especially full function (heating, cooling, and electrical) systems are installed as aftermarket equipment. This significantly drives up the cost of installation and leads to other complications. Installing a system on line at the truck OEM is estimated to save at least $1000 per unit, while significantly improving the availability of parts and maintenance, permitting financing as an option with the truck, increasing residual book value, and improving consumer acceptance. In short, for full function idle reduction systems to become mainstream within the trucking industry, they must be installed online at truck OEMs. DOE will work with truck OEMs to overcome barriers to on-line installation.

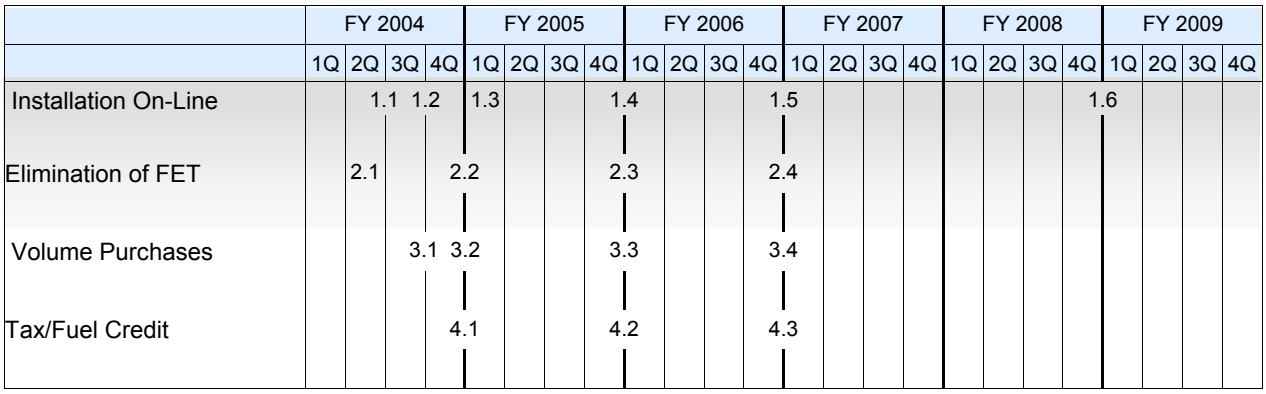
A 12 percent Federal excise tax (FET) is currently applied to the purchase of accessories/options for on-road heavy duty trucks. This excise tax adds approximately $700-900 to the purchase and installation of full function idle reduction systems. It is dubious as to whether this tax should apply to idle reduction systems given that they are explicitly used while the truck is not moving and offer clear petroleum displacement and environmental benefits to the Nation. Efforts to eliminate the FET would primarily be the responsibility of an industry group or association.

Presently, manufacturers of full function idle reduction systems produce only a few hundred units per year. It is estimated that increasing production by an order of magnitude to approximately 2000-3000 units/year would drive down costs 10 to 15 percent. Cost savings would be achieved through volume discount rates on parts (such as motors) from suppliers and consolidation and improved synergism of overhead functions. It is thought that one of the key requirements to encourage truck OEMs to install systems online is to demonstrate proven demand from the fleets. Identifying and consolidating fleets interested in specific idle reduction technologies, and organizing them into buyer groups can help build the volume necessary to drive down costs and encourage truck OEMs to install on-line.

Another possible avenue for reducing cost is pursuing a tax/fuel credit for the installation and use of idle reduction technologies. In recent years, there has been activity on legislating a Federal tax credit for the purchase of hybrid vehicles for the general consumer. A light duty hybrid vehicle would save only about 150 gallons of gasoline a year. A full function idle reduction system applied to a conducive heavy duty fleet would save 1500-2000 gallons of diesel fuel per year providing a significantly higher return on investment for the Federal government. Unfortunately, given current Federal budget deficits, obtaining a tax or fuel credit could be difficult in the near term. This effort, should it be undertaken, would primarily be the responsibility of a industry group or association,

Figure 2 illustrates the implementation schedule for cost reduction strategies for idle reduction technologies for heavy duty trucks. The first priorities are to establish and implement a plan to achieve installation of idle reduction technologies on-line at truck OEMs followed by elimination of the 12% Federal excise tax. Subsequently, formation of buyer groups leading to volume purchases may be pursued to further drive down costs—especially if necessary to facilitate installation on-line at truck OEMs. Finally, advisory support may be provided to industry led groups/associations (such as the Idle Elimination Manufacturers Association) in the pursuit of tax, fuel or similar credits for idle reduction technologies. Eliminating the 12% FET or pursuing tax/fuel or similar credits should be pursued jointly, and if successful, would make on-line installation and volume purchases much easier.

Figure 2. Cost Reduction Strategies Implementation Schedule



1.1 DOE/Truck OEMs identify critical issues/barriers to installation on-line of full function (heating, cooling, electrical) idle reduction systems
1.2 DOE (in concert with truck OEMs) develop plan/strategy to overcome barriers to on line installation.
1.3 Initiate implementation of on line installation plan/strategy with truck OEMs.
1.4 Receive firm commitment from at least 3 major truck OEMs to install full function idle reduction system on-line.
1.5 A minimum of 3 major truck OEMs have integrated full function idle reduction system on-line.
1.6 Most major truck OEMs have integrated full function idle reduction system on-line.
2.1 Formation of nonprofit idle elimination manufacturer association (industry lead)
2.2 Identify strategy leading to elimination of FET for idle reduction systems. Initiate implementation (industry/Government)
2.3 Achieve legislative success eliminating FET (industry/Government)
2.4 FET eliminated for idle reduction systems (industry/Government)
3.1 DOE develop strategy for organizing buyer groups (fleets) to achieve volume purchases
3.2 Initiate implementation of buyer group/volume purchase strategy (as necessary)
3.3 Achieve volume purchase commitment ($\geq$2000 units/yr) for at least 1 full function idle reduction technology
3.4 Achieve volume purchase ($\geq$2000 units/yr) for at least 1 full function idle reduction technology
4.1 identify strategy to achieve Federal tax/fuel credit (industry/Government)
4.2 Achieve legislative success in establishing Federal tax/fuel credit (industry/Government)
4.3 Federal tax/fuel credit effective (industry/Government)

4.3 Reliability, Durability, and Maintenance

It is important for the reliability, durability, and service intervals of idle reduction technologies to match those of the trucks. The minimum average preventive maintenance schedule for fleets is approximately 13,600 miles, while owner operators do maintenance every month or two. Idle reduction technologies require basic maintenance (oil, filter changes) every one to two months. Truck life is about 10 years and 1 million plus miles, while the life of idle reduction technologies are usually 3-7 years (some longer). Large fleets typically keep vehicles 4-6 years (400-1000K miles) while owner/operators typically keep

them 5-7 years (400-800K miles) or on average 6.4 years. Warranties for idle reduction technologies are on the order of 1-3 years or about 2000 hours.

Ideally, idle reduction technologies should have lifetimes of 20,000+ hours (or 10+ years) and maintenance and service intervals of not less than 13,600 miles to match those of trucks. One of the biggest barriers is the life of the motor which can vary significantly. It may be advantageous to pursue efforts with small motor manufacturers such as Kubota on extending the life of motors applicable to idle reduction technologies. Maintenance intervals can be extended through a number of means including incorporation of larger oil pans and improved filtering technologies. Improvements in reliability, durability, and maintenance is primarily the responsibility of the idle reduction technology manufacturers. Government may have a role with regards to R&D (such as improved filtering technologies) and through consultations with motor manufacturers.

4.4 Driver Acceptance

A device or technology that provides driver comfort while at the same time eliminating idling is important because most drivers sleep in their trucks. 1997 research by the University of Michigan Trucking Industry Program found that 70.1% of the drivers contacted had slept in the bunk of their truck the previous night, 23.5% slept at home, 4.3% in a motel, and 1.2% in their truck but not in a bunk. Driver education/training/ receptiveness is a major barrier facing idle reduction technologies with nearly one-third of major truck fleets identifying it as the principal barrier. Drivers idle for a number of reasons including the lack of other available options to provide necessary heating, cooling, and electrical functions; habit; because other truckers do; and as a form of "white noise" when sleeping.

While it is primarily the responsibility of fleets to encourage driver acceptance, Government may also incur a role. For example, Government could play a role by reframing idle reduction from strictly a fuel savings and emissions benefits viewpoint, to one that includes enhancing driver capabilities and comfort. Examples could include highlighting the ability to power electrical devices such as microwaves and small refrigerators; televisions and computers; and providing emergency back-up power. Government can also promote the benefits of idle reduction and its appeal to the greater good of society. Section 4.6 Education and Outreach discusses in more detail DOE's potential role in promoting idle reduction technologies.

4.5 Weight/Size

Idle reduction technologies that combine heating, cooling, and electrical functions typically weigh 300-400 lbs. Truck manufacturers indicate that these systems should weigh about 100 lbs and are in general are too bulky (8-15 cubic feet) as opposed to the required 6-8 cubic feet. While in general weight has not been identified as a major barrier, it is an impediment for some fleets. In November 2003, an omnibus Energy bill was defeated in Congress which included a 250 lb weight exemption for idle reduction technologies, as well as funding for deployment. Achieving weight reduction and renewed efforts in the future to obtain weight exemptions via legislation should be pursued by industry.

4.6 Education and Outreach

The lack of fleet, driver, and public awareness of and receptiveness to idle reduction technologies is a critical barrier. It is essential for the trucking industry and public to be

aware of the economic, health, and driver enhancement benefits and successful fleet applications of idle reduction technologies. Grass roots support is essential to push idle reduction technologies toward broad market appeal. The following identifies a number of areas where Government education and outreach efforts would be appropriate. To increase validity and acceptance, information must be unbiased and objective representing real world driving conditions, while emanating from respected neutral parties. Channels used to disseminate the information are also key to increasing exposure and acceptance.

Fleet Data Collection/Demonstration Projects

Information on the cost/payback, performance, maintenance requirements, driver impressions, and availability of idle reduction systems must be available in user friendly formats to a broad cross section of the trucking industry. DOE is supporting and managing idle reduction projects starting in FY03 to obtain appropriate information. Data will be generated and collected by the demonstration teams and forwarded to DOE where it will be analyzed, organized, and as appropriate, subsequently published.

Cost Reduction Activities

It is advantageous and appropriate to engage the trucking industry and public in Government cost reduction activities. Cost has been clearly identified as the principal barrier preventing the mainstreaming of idle reduction technologies. Trucking industry and possibly public involvement will be instrumental for successful efforts to eliminate the Federal excise tax, obtain fuel/tax credits, and to build sufficient volumes necessary to jumpstart the idle reduction industry. Trucking blue books are now beginning to list residual resale values for heavy duty trucks equipped with idle reduction systems. Knowledge of this residual resale value is somewhat limited within the trucking industry and increasing awareness will improve the business case for idle reduction technologies.

Successful Fleet Applications

An excellent way to increase interest is to identify key fleets successfully using idle reduction technologies and to determine their motivation and results. Potential consumers will then realize that idle reduction technologies can make a strong business case in certain fleet applications. Identification of successful fleet applications can be achieved in several ways, via contacts from idle reduction technology manufacturers or through direct communication with fleets. When promoting this, it is essential to clearly understand the fleet application and to present all information in forms conducive to end users.

Health Benefits

Largely as a result of truck idling, the air quality at truck stops, rest areas, and loading docks is very poor. By investigating air quality at these locations, health and other long term benefits of reduced idling can be promoted. Possible targets include not only fleets and drivers but their families and loved ones as well. In this way, efforts can be made to break truckers ingrained habit to idle and show it is unhealthy and "uncool" to idle. This activity should be led by the Environmental Protection Agency with the Department of Energy providing support as necessary along the way. For this effort, coordination with the Driver Wellness Program of the Federal Motor Carriers Administration may be in order.

Reframing Idle Reduction

Traditionally, idle reduction has been promoted by focusing on fuel use reduction and emissions benefits. Unfortunately, these aspects often do not strongly resonate with fleet drivers. By reframing the scenario to promote "driver enhancement" aspects, greater user interest and reception can be achieved. For example, promoting the flexibility for additional driver amenities such as larger refrigerators, microwaves, or laptop computers, and useful backup power during failure of the truck's main engine could be very appealing.

Educating the Trade Press

A number of fleets are using idle reduction technologies and in general have been satisfied with their results. Educating the trade press to this fact and increasing their knowledge of this topic in general would be highly beneficial. A directory explaining the different idle reduction strategies, the technologies available, benefits, and results of demonstration projects would be beneficial in educating the trade press and increasing their willingness to publicize information and promote the technologies. Other possibilities could include a monthly column, "Idly Yours," where stories are shared, results reported, and so forth.

Education and Outreach Dissemination Mechanisms

The primary source of trucking information for fleets and owner-operators, respectively, are industry trade magazines (81%/79%), truck manufacturers (63%/30%), other truckers (NA/36%), engine manufacturers (63%/23%), America Trucking Associations/Technology Maintenance Council (60%, NA), truck dealers (NA, 28%), truck mechanics (NA, 18%), and the Federal Government (15%/6%). Results indicate that favored information dissemination mechanisms for fleets and owner-operators, respectively, are industry publications (80%/87%), industry conferences (33%/31%), electronic newsletters (38%/6), the world wide web (21%/17%), and Government publications (13%/9%). Primary industry publications to target include *Heavy Duty Trucking* and possibly others by Newport Publications, *Landline* by the Owner Operator Independent Drivers Association (OOIDA), and *Transport Topics* by the American Trucking Associations.

Figure 3 illustrates the proposed implementation schedule for education and outreach activities for idle reduction technologies. The first priority is the development of a comprehensive education/outreach plan. The next two priorities are 1) to secure agreement from Presidio on highlighting their blue book resale value of $3500 in an awareness campaign and 2) developing an outreach package for educating and gaining the cooperation of the trade press in broadly publicizing idle reduction. By early FY 2005 results from the data collection/demonstration projects should be available for dissemination. Finally, successful fleet applications and health benefits should be identified and an awareness campaign undertaken.

Figure 3. Education and Outreach Implementation Schedule

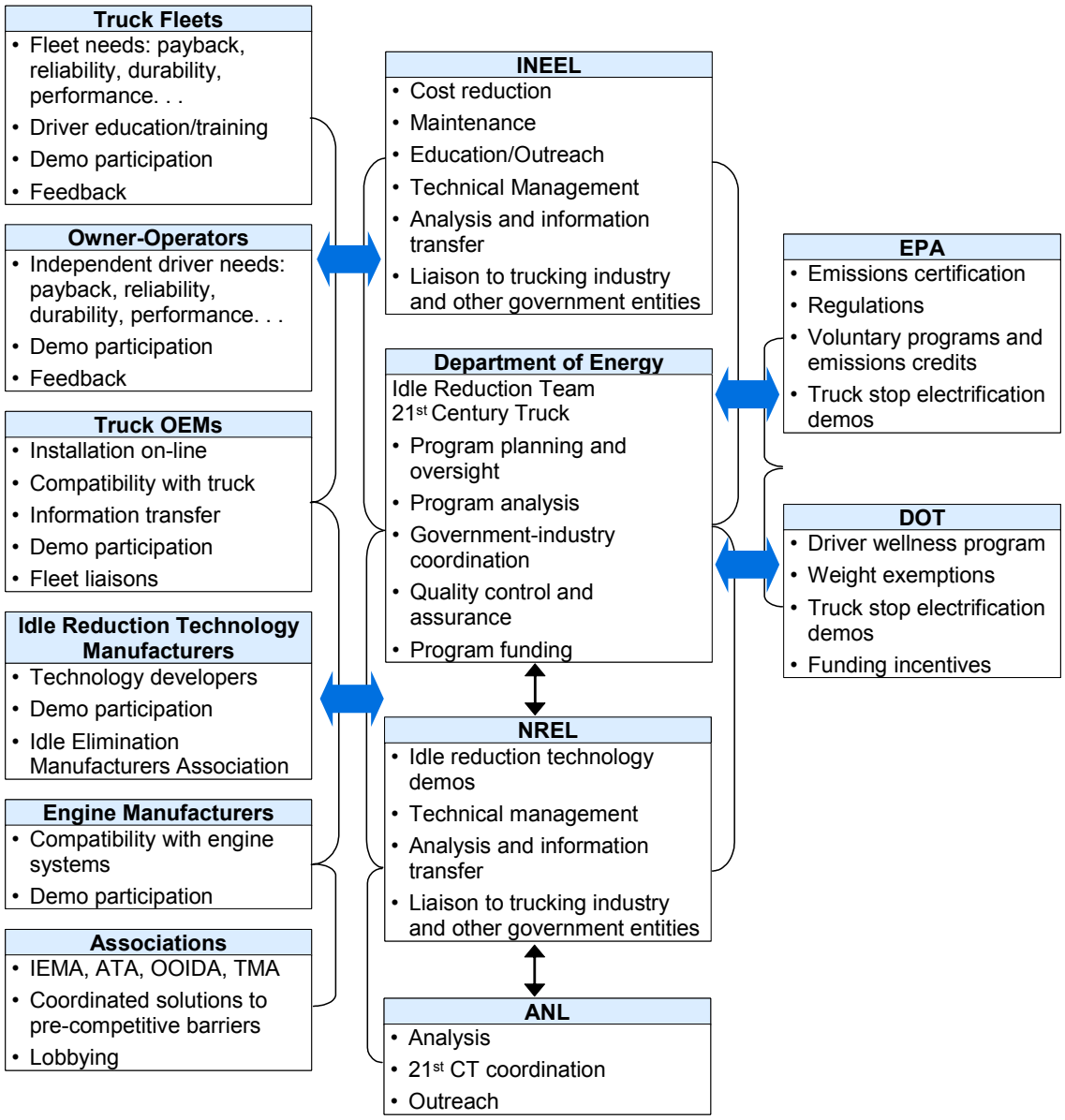
	FY 2004				FY 2005				FY 2006				FY 2007				FY 2008				FY 2009			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Education/Outreach Plan			1.1	1.2																				
Conduct Education/ Outreach				2.1 2.2	2.3	2.4	2.5		2.3	2.4	2.5		2.3	2.4	2.5									

1.1 Prepare draft education/outreach plan
1.2 Prepare final education/outreach plan
2.1 Outreach on Presido residual resale value ($3500) of idle reduction systems
2.2 Prepare/distribute education package for trade press
2.3 Outreach – successful fleet applications
2.4 Outreach to fleets, owner-operators, public on fuel /cost, maintenance, engine wear . . . savings (results from demos)
2.5 Outreach – health benefits

5.0 Management Approach

A team effort that includes truck fleets and owner operators, truck and engine manufacturers, other Government entities, the Idaho National Engineering and Environmental Laboratory (INEEL), National Renewable Energy Laboratory (NREL), Argonne National Laboratory (ANL), and staff at DOE headquarters is necessary to achieve the goal and objectives of this plan for on-board idle reduction technologies. Figure 4 depicts the roles and responsibilities of the major participants in this effort, with the responsibility for implementing and managing the effort residing at DOE headquarters, INEEL, and NREL.

Figure 4 The Roles and Responsibilities of Key Players for Idle Reduction Technologies



5.1 Programmatic Resources

In FY03, the first of three industry teams each consisting of a technology manufacturer, truck fleet, and truck OEM kicked off data collection/demonstration projects for idle reduction technologies. In FY04, cost reduction and education/outreach activities are scheduled to commence. Table 2 below presents the estimated annual funding for data collection/demonstration, cost reduction, and education/outreach activities for idle reduction technologies by the DOE Office of FreedomCAR and Vehicle Technologies. This table includes funding from the Advanced Vehicle Testing Activity as well as Heavy Vehicle Systems.

Table 2. Budget for Idle Reduction Technologies

Program Activity	FY03 ($ thousands)	FY04 ($ thousands)	FY05 Planned ($ thousands)
Idle Reduction Technologies	610	710	1000

5.2 Coordination

To successfully collect pertinent data, demonstrate, and encourage the introduction of idle reduction technologies in heavy duty trucks, strong intra-Government and private sector coordination will be necessary. For example, DOE expects to work with the following Government entities.

- Environmental Protection Agency Office of Transportation and Air Quality
- Department of Transportation Federal Motor Carrier Administration
- New York State Energy Research and Development Agency
- California Air Resources Board
- California Energy Commission
- Office of Hydrogen, Fuel Cells, and Infrastructure Technologies
- Pacific Northwest National Laboratory
- University of California – Davis
- Federal Highway Administration

In the private sector, DOE will work with:

- Truck fleets and owner-operators
- Truck and engine manufacturers
- Idle reduction technology manufacturers
- Industry associations (i.e., idle elimination manufacturers association, American Trucking Associations, Owner-Operator Independent Drivers Association, and the Truck Manufacturers Association)
- Industry/trade publications

DOE will provide support to industry through various mechanisms including the idle elimination manufacturers association and the 21st Century Truck Partnership.

5.3 Action Plan

The following are the highest priority, near term action items for implementation of data collection/demonstration, cost reduction, and education/outreach activities for idle reduction technologies. Table 3 presents these action items, proposed milestones, and estimated costs for implementation by the Advanced Vehicle Testing Activity. Implementation of this action plan cannot be undertaken or will be significantly delayed without funding support.

Table 3. Budget for Idle Reduction Technologies

Activity	Milestone Date	Estimated Cost ($K)	
		FY04	FY05
1) Data Collection Demonstration			
Award a third demonstration contract	3Q, FY04	110	
Award SEP idle reduction grant via Clean Cities	3-4Q, FY04	100	100
Extend data collection periods of existing contracts to capture valuable component wear data	4Q, FY04	50	50
Laboratory support to demonstration projects	FY04	100	100
	Subtotal	**360**	**250**
2) Cost Reduction			
DOE/truck OEMs identify critical issues and barriers to installation on-line of full function (heating, cooling, electrical) idle reduction systems	2-3Q, FY04	25	
DOE/truck OEMs, develop solutions/plan to overcome barriers to on-line installation	3-4Q, FY04	25	
Initiate financial assistance awards for idle reduction technology integration on assembly line. Implement plan to issue two $250K awards for R&D at truck OEMs.	4Q, FY04 – 1Q, FY05	40	550
	Subtotal	**90**	**550**
3) Education and Outreach			
Prepare education/outreach plan	4Q, FY04	20	
Communicate residual resale values for idle reduction technologies	4Q, FY04	10	
Prepare/distribute education package to trade press	4Q, FY04	15	
Participate in Albany, NY idle reduction industry workshop	3Q, FY04	10	
Additional education and outreach			50
	Subtotal	**55**	**50**
	TOTAL	**505**	**850**

Appendix A: Demonstration/Evaluation Workshop Results

April 15, 2003
Philadelphia, PA

The goal of this workshop was to solicit input and gain feedback and guidance from industry to help tailor a request for proposals (RFP) for demonstration projects for heavy duty truck idle reduction technologies. Another goal was to glean information from industry to augment the idle reduction technology demonstration plan and this technology introduction plan. The idle reduction technology demonstration plan (found under separate cover) lays the framework for demonstration and evaluation efforts to gather objective in-use information on the performance of idle reduction technologies by characterizing the cost; fuel, maintenance, and engine life savings; payback; and user impressions of various systems and techniques.

Specific objectives of the demonstration/evaluation workshop were to 1) develop a prioritized list of data to be gathered during idle reduction technology demonstrations, 2) determine appropriate protocols for data collection, and 3) develop methods for estimating the economic value of engine wear and maintenance reductions resulting from the use of idle reduction technologies. Thirty-seven participants from industry and Government gathered to address these objectives. The following exhibits (A-1 through A-5) provide workshop results in raw, tabular form. Two parallel sessions were conducted each addressing the same questions and objectives identified above. Each session identified somewhat different categories and ways to organize their information. The items in the tables were identified via questions and answers and dialog among session participants and a facilitator. The diamonds represent the results of voting (or consensus) by session participants, where items with more diamonds are deemed to be the most critical.

EXHIBIT A-1. TYPES OF DATA IR TECHNOLOGY DEMONSTRATIONS SHOULD SEEK TO DEVELOP

◆ = MOST CRITICAL DATA TYPE

VALUE CREATION	DRIVER ACCEPTANCE	PRE AND POST DATA	IDEAL BUT INFEASIBLE	NOTES
• **Fuel consumption – *this is the most critical data type to be collected, no voting required***	• Driver acceptance ◆◆◆◆	• Loads and duty cycles ◆	• Operating conditions (ambient and interior temperatures, region/route history, noise, etc.)	• May require tax incentives, etc. for IR technologies to become broadly accepted
• Pay back time (cost per mile) ◆◆◆◆◆◆◆◆◆◆	Reliability	• Establish an idling standard definition (could use the definition in the Energy Bill)		• Value may be found in TMC efforts that are similar in nature
• Differentials between IR truck and standard truck ◆◆◆◆◆◆◆	Features	• Amount of wasted energy and resources due to engine idling		
• Reliability of system ◆◆◆◆◆◆◆	Customer experiences including comfort levels	Resources associated with oversized engines		
• Initial costs ◆◆◆	Track by reduction in idle time	• Percentage of time at full load (time vs. load data)		
Based on retrofit or OEM	• Noise level	• Driver incentive plans		
• Maintenance comparisons, analysis ◆◆		• Time required for driver training on IR technologies		
• Hours of engine use in 1) in motion, 2) not in motion, 3) still and hotel loads ◆◆		• Levels of emissions		
Type of hotel loads being used		• TMC data on R factor of cabs		
• Amount of alternative energy used		• Fleet profile and vehicle types		
• Oil changes tracked by engine hour not engine miles				

EXHIBIT A-2. PROTOCOLS DEMONSTRATIONS SHOULD USE TO ENSURE DATA IS ACCEPTED BY INDUSTRY

DATA TYPE	DATA PROTOCOLS
Value Creation: Fuel Consumption	• Load versus speed charting fuel consumed during engine idle and driving • Quantify percent of idle time required before and after IR technology installation to achieve desired payback periods • Quantify savings opportunities in states that allow rebate of state/federal road tax for fuel consumed by IR technologies
Value Creation: Hours of Engine Use	• Simple data collection protocol from engine computer
Value Creation: Initial Costs	• Purchase cost and installation costs
Driver Acceptance	• Tracking idle time may reveal acceptance (significant idle reduction may equate to more acceptance) • Gauge driver acceptance at end of demonstration ("would you do this again with your own money?") • Track number of operator overrides • Note: system reliability is tied to acceptance
System Reliability (early-hour unreliability)	• Cost for repairs (including downtime cost) due to malfunctions This quantifies the cost of technology failure May be susceptible to low sample size issues Subtract regular failure costs of standard equipment • Cost avoidance in other systems due to redundant systems (e.g., alternators) Jump starts/road service calls
Maintenance Comparisons and Analysis	• Time and cost for maintaining IR system • Frequency of oil changes

EXHIBIT A-3. POSSIBLE METHODS FOR ASSIGNING ECONOMIC VALUE TO REDUCED WEAR/MAINTENANCE DUE TO IR TECHNOLOGIES

• Reduced number of engine hours may increase resale value This may be particularly relevant for owner-operators • Wear and maintenance costs for accessories may be reduced due to lower idle time E.g., Injectors, turbo-charger seals, battery life, alternator life, fan clutch, starting • Deferred oil changes (conduct oil analysis) • Engine tear-downs at 1 million and 2 million miles may reveal engine wear savings • Highly dependent on fleet profile • Use published information (TMC) subtract fuel and see what additional savings are present

EXHIBIT A-4. TYPES OF DATA IR TECHNOLOGY DEMONSTRATIONS SHOULD SEEK TO DEVELOP

◆ = MOST CRITICAL DATA TYPE

ACQUISITION COSTS AND SPECS	OPERATING COSTS	OWNERSHIP COSTS	OTHER EVALUATION DATA
• IR system capital cost ◆◆◆◆◆◆◆◆ • IR system installation costs • IR system descriptions Weight	• Fuel use at idle ◆◆◆◆◆◆◆◆◆◆◆ • Fuel consumption ◆◆◆◆◆◆◆◆◆◆◆◆◆ • Vehicle operating cycle ◆ • IR system usage in service (hours/%)	• Maintenance ◆◆◆ • Longevity/durability ◆◆◆ • Other component lifetimes (alternators, etc.) • Engine oil consumption and changes	• User satisfaction ◆◆◆ • Truck emissions at idle ◆ • IR technology emissions ◆ • Resale value • Temperature operated in • Routes traveled Comparable routes for both IR and control vehicles • Noise level • Engine overhaul costs

Other discussion items of interest:

- Customer weight demands sometimes limit application of IR technologies
- Fleets generally dictate to OEMs what they want on their trucks
- 90+% of trucks owned by fleets with less than 20 trucks
- Industry publication expected to start providing resale value for trucks with different IR technologies installed

EXHIBIT A-5. PROTOCOLS DEMONSTRATIONS SHOULD USE TO ENSURE DATA IS ACCEPTED BY INDUSTRY

◆ = MOST IMPORTANT PROTOCOL

DATA COLLECTION				DEMO PARAMETERS	
USER SATISFACTION	**FUEL USE AT IDLE** ◆	**IR FUEL CONSUMPTION**	**MAINTENANCE**	**SAMPLE SIZE* (IR AND CONTROL EACH)**	**LENGTH AND REPORTING**
• Require a standard data collection tool ◆◆ • Assess satisfaction before and after demonstration ◆◆ • Education/training • Operator controls	• RPM measurement ◆◆◆◆ • Beaker tests ◆◆◆◆ • SAE-3 (only rolling currently)	• Outside testing ◆◆◆◆◆◆ • Idle Percentage ◆◆◆◆ • Number of hours IR equipment operated ◆◆◆ • Uptime/downtime/$ ◆ • Flowmeters or separate tank ◆ • Vehicle operating data ◆ • Use SAE standard?	• Ensure good recordkeeping ◆◆◆◆ • Capture and distinguish scheduled and unscheduled maintenance ◆◆◆ • Capture second order benefits if possible ◆	• Less than 15 ◆◆◆◆ • 15-25 ◆◆◆◆ • 25-40 ◆◆◆◆ • 40-60 • 60+	• Two full seasons • Interim 1 year report • Preliminary assessment of technology after a few months • Long-term evaluation desirable • Minimum number of miles traveled • Single driver throughout demo • Comparable/consistent testing methods/requirements

* Each participant was required to vote for one sample size from the five choices

Other discussion items of interest:

- Department of Transportation has used sample sizes of 50 for some applications (e.g., tire testing)
- Some existing technology demonstrations are using sample sizes of 100 in existing fleets; while others are using 30
- EPA has published data from a controlled, off-road test, including:
  Fuel
  Emissions
- Idea was raised as to whether a single fleet should evaluate multiple technologies (e.g., 10 technologies)?
- R.O.I. is key for adoption
- Drivers often not currently forced to use the IR technology installed on their truck; how can incentives be employed to ensure utilization of the installed IR technology?

Appendix B: Cost Reduction Workshop Results

September 12, 2003
Cincinnati, OH

The purpose of this idle reduction technologies workshop was to identify methods and establish a foundation for cooperative Government/industry efforts to overcome cost barriers to the acquisition and use of idle reduction technologies in heavy duty trucks. Specifically, this workshop was to identify and develop 1) a prioritized list of technical, market, and policy strategies to address cost barriers; 2) a prioritized list of critical issues and possible solutions for technical, market, and policy strategies; and 3) key elements of strawman action plans leading to implementation of cost reduction strategies. Fifty participants from industry and Government gathered to address these objectives.

The following exhibits (B-1 through B-9) provide workshop results in raw, tabular form. Three sessions were conducted one each for technical, market, and policy strategies. The items in the tables were identified via questions and answers and dialogue among session participants and a facilitator. The diamonds represent the results of voting (or consensus) by session participants, where items with more diamonds are deemed to be most critical.

EXHIBIT B-1. POTENTIAL MARKET STRATEGIES TO ENCOURAGE IR TECHNOLOGY DEPLOYMENT BY REDUCING COSTS

◆ = MOST CRITICAL STRATEGY

MARKET CHARACTERIZATION	MARKET INCENTIVES	VOLUME PURCHASING	SECONDARY BENEFITS	AWARENESS
• Identify the most appropriate market sectors and factors (understand the cost/market curves) ◆◆◆◆◆◆ • Market segmentation ◆◆ • Determine which sectors will benefit in which ways by which systems	• No user cost to use things like shore power at public facilities and very low (maybe standardized cost at private locations. ◆◆◆◆◆ - Energy commissions and utilities may offer incentives ◆ • Establish a data/download incentive ◆◆◆◆ • Encourage OEMs to offer incentives to dealers to promote the sale of IR-equipped trucks ◆◆ • Provide incentives to truck OEMs to offset engineering costs of implementing IR technology ◆	• Need government incentives to jump-start the industry to moderate volumes ◆◆◆◆ • Federal/state truck buyers can be first to require IR technologies in their trucks to establish volume ◆◆ - Or require subcontractors to use trucks with IR technologies to transport government goods	• Apply some portion of driver training towards IR systems ◆◆◆◆◆◆ - Drivers are trained – then leave; this could make your fleet more appealing to drivers while also reducing wasted training expenditures • Investigate air quality at truck stops; promote health effects and other long-term benefits to drivers ◆◆◆◆◆◆ - Truck stop incentives to drivers not idling • Demonstrate driver/workers health benefits ◆◆◆◆ • Get NADA and Truck Blue Book to list resale values of IR equipment (determine resale value to establish data) ◆◆ • Consistent data reporting standards to government agencies • Quantify jumpstart costs, engine wear costs alternator costs that are delayed	• Conduct awareness campaign ◆◆◆◆◆◆◆◆◆◆◆◆◆ • Identify key fleets successfully using IR technologies and determine their motivation and results ◆◆◆◆◆◆◆ • Form an industry led group to organize an approach to lobbying & collaboration ◆◆◆◆◆◆ • IR solutions should avoid truck start-ups at all (otherwise no better than fuel-fired motors) ◆◆◆◆ • Hold press conference, enlist cooperation of trade press (trucking and business) to promote idling reduction ◆◆◆ • Convince drivers that it's not "cool" to let their engines run ◆◆ • Package and standardize information to educate owners and fleets about the technologies that already are in the market ◆ • Publicize possible economic savings in fuel and fines

EXHIBIT B-2. KEY ISSUES/BARRIERS TO IMPLEMENTING THE HIGH-PRIORITY MARKET STRATEGIES

MARKET CHARACTERIZATION	MARKET INCENTIVES	VOLUME PURCHASING	"SECONDARY" BENEFITS	AWARENESS
• Geography of operations and routes create complicated cases where climate has to be considered in IR data reporting • Fleet owners will start rebelling if people keep asking for information and in different formats – standardize the data requests • Shore power vs. APU – are these competing routes? Which way is government going? • Price of fuel is a key payback factor (e.g., in Canada, fuel is 2-2.5 times more expensive, and IR technologies have gained use) - Different financing programs – lease it, investment strategy • Trucking industry has low margins and limited capital and cash flow	• High cost of incentives to OEMs • Disputes on who should receive the incentives • No government funding or leadership to push IR technologies (not just Federal) • OEMs need to have re-sale value – IR techs have benefit to secondary market, but it is not quantified or promoted • OEM "Green Truck" program 10 yrs out, for purpose of environmental benefits - Demo program • Government regulations are an issue (federal, state, local)	• Lower-end units could generate more volume • Volume is interdependent on other activities • IR technologies face the same emerging market issues that other technologies do: everyone wants to wait until technologies improve and come down in cost. • Overcoming basic skepticism	• Driver culture is not receptive to additional burdens (education/ training) • Capital and infrastructure costs • Difficulties in communicating the health benefit – drivers are not always concerned with the long term • How do we include all the costs that are incurred by not using IR technology • We do not account for public costs/value for reduced emissions and other benefits	• Creating the unified message • Identifying the target audience - Avoid impression that awareness efforts are motivated solely by sales • Need single voice to not burden people with too much data • Identifying the lead for this awareness campaign (government, fleets?) • Owners are always told they can add components to their trucks and lower cost; IR will be viewed as just the most recent case of this • Consider other audiences - Spouses - Family members • Make sure data used in generating awareness are clear and traceable • Which avenues will be used to create awareness?

EXHIBIT B-3. PRELIMINARY ACTION PLANS FOR ADDRESSING KEY MARKET COST REDUCTION STRATEGIES

HIGH PRIORITY MARKET STRATEGY TO ENCOURAGE DEPLOYMENT BY REDUCING COSTS	METHODS TO ADDRESS KEY ISSUES AND BARRIERS	MILESTONES	ROLES OF GOVERNMENT, INDUSTRY, AND FLEETS
Establish market incentives for using IR technologies - No/low cost to use of shore power at public facilities - Data download incentives	• Use information from market segmentation study to develop and deliver a consistent message to government, fleets, and industry • Collect idle hours data for publications • Clearly state the single goal of "Idle Reduction"	• Idle reduction becomes non-dated issue from an elected body (Congress) • Customer accepts delivery of 10 OEM-equipped, zero-idle trucks without subsidy	• Government: coordinate infrastructure requirements (i.e., shore power and APUs) • Fleets: continue/start providing incentives to drivers for no idle time
Identify most appropriate market sectors and factors influencing payback (understand cost curves)	Form a small industry-wide group with cross-functional representation	Three months	
	Identify types of market data desired (size/-segments)	Two months after group is formed	
	Determine or otherwise obtain existing data (for each segment) regarding factors that drive acceptance for each segment	Three months after data types are defined	
	Develop analysis tool to determine need for IR, extent of IR needed, practices for fleets versus owner operators, and factors that could drive acceptance	Four months after data is obtained	
Conduct an IR awareness campaign	• Form IR team - Trade shows/events - Publications - On-line - Other media (radio, broadband) - collateral material • Truck stop campaign program • Ask fleets who use IR today about their choices and experiences	• 3-6 months: Utilize existing organizations to influence members and legislation • 3-6 months: Co-op marketing group	• Fleet – validate IR technologies • Industry – drive plan • Government – launch incentives

HIGH PRIORITY MARKET STRATEGY TO ENCOURAGE DEPLOYMENT BY REDUCING COSTS	METHODS TO ADDRESS KEY ISSUES AND BARRIERS	MILESTONES	ROLES OF GOVERNMENT, INDUSTRY, AND FLEETS
Work to establish government incentives to jumpstart volume purchasing	• NOx tax credit: Provide 1 year extension on 2007 emissions for trucks with factory-installed IR technology	• Formulate plan – conclusion of DOE field test	• Government – EPA, DOE • Industry OEMs, Engine Manufacturers • Fleets – lobby efforts with ATA, etc.
	• Government Equipment: Federal freight (contracted or owned) requires 3 minute idle shutdown	• 2004 completion	• Federal government implement at time of new contracts • Industry provide “no tamper solution” • Fleets – educate drivers
	• Weight (GVW) relief for IR technologies	• DOT safety study for adding 500 lbs complete by 2004	• DOT • Industry – educate DOT that trucks are capable • Fleets – Educate!
	• Fuel tax rebate for IR equipped trucks	• Formulate plan and legal defense for non-highway use	• Government excise tax review • Industry – tamper proof technology • Fleets – compile data to justify
Demonstrate and promote secondary benefits of IR technologies (e.g., driver health benefits)	• Promote all locations where drivers congregate		• Regulation (anti-idle legislation) • Education of drivers about secondary benefits

EXHIBIT B-4. POTENTIAL TECHNICAL STRATEGIES TO ENCOURAGE IR TECHNOLOGY DEPLOYMENT BY REDUCING COSTS

◆ = MOST CRITICAL DATA TYPE

RESEARCH & DEVELOPMENT	AFTER MARKET	STANDARDS	MAINTENANCE COSTS	TRUCK OEM INSTALLATION	NOTES
• Phase change thermal storage unit • Develop light and cost-effective APU (R&D is in the works) ◆◆◆ • Increase efficiency of APU • Engine/fuel issues of 2007, 2010 may create more interest in APU systems –difficult to assess until more info received from OEMs ◆◆ • Make technology transparent to truck operator • Redesign truck electrical system so that it will support current and future electrical-based IR technologies – it doesn't currently ◆◆ • Electrify truck to allow diesel APU to only be an electric generator (e.g., 1 cylinder diesel APU) ◆	• Ease of installation and removal ◆◆◆◆◆◆◆◆◆◆ Minimize retrofit time	• Establish performance and safety standards ◆◆◆◆◆◆◆◆◆◆◆◆ • Develop common equipment (onboard) standards among APU manufacturers ◆◆ • Determine geographical climatic impacts on performance and technology selection	• Quantify and minimize maintenance costs ◆◆◆◆◆◆◆	• Installation on-line ◆◆◆◆◆◆◆◆◆ ◆◆◆◆◆◆◆◆◆ Will be OEM-driven Require OEM system integration • Minimize energy requirements for HVAC system through better cab insulation ◆◆◆◆◆◆◆◆ • Use as many existing systems and parts as possible; limit add-on equipment	• Tighter control on allowed idle times (e.g., no idling when operator is in the sleeper) • New hours of service may change allowable idle hours, especially with the 34-hour reset → technology must comply to this rule • Electrify non truck stop locations (e.g., shippers/receivers, rest areas) • Develop truck stop electrical standard (e.g., 220 Volts AC, 30 Amps)

EXHIBIT B-5. KEY ISSUES/BARRIERS TO IMPLEMENTING HIGH PRIORITY TECHNICAL STRATEGIES

MINIMIZE ENERGY REQUIREMENTS FOR HVAC (CAB INSULATION)	ESTABLISH PERFORMANCE, SAFETY, AND OTHER STANDARDS	OEM SYSTEM INTEGRATION TO DRIVE COSTS DOWN	MAINTENANCE COSTS	EASE OF AFTERMARKET INSTALLATION AND REMOVAL
• Additional cost • High performance materials (non-traditional truck materials such as Thinsulate™) are costly • Set insulation standards • Reduce energy needs of APUs • Added weight Investigate new methods and alternative insulation products	• Encourage communication between manufacturers and IR technology suppliers • Ease of use for truck operators • Need standard interface • Inconsistent state-to-state/global standards	• Lack of integration of truck engine and APU R&D needed • Lack of: Underhood APU Modular, plug 'n play APU OEM-installed APU • Meeting 2007, 2010 emissions requirements • Impacts of globalization Europe is anti-idling • Accessibility to various APU parts for maintenance • Minimize duplication of parts/units between truck and APU (i.e., electricity-driven compressor) • Life cycle costs are too high	• Need R&D to reduce costs • Maintenance cycles for truck and APU are not the same Make same or minimize APU maintenance cycle • What is it in maintenance costs that drive them up?	• Need for qualified, trained technicians • Need cooperation between IR technology companies to develop similar installations Technician can install several brands of APUs

EXHIBIT B-6. PRELIMINARY ACTION PLANS FOR ADDRESSING KEY TECHNICAL COST REDUCTION STRATEGIES

HIGH PRIORITY TECHNICAL STRATEGY TO ENCOURAGE DEPLOYMENT BY REDUCING COSTS	METHODS TO ADDRESS KEY ISSUES AND BARRIERS	MILESTONES	ROLES OF GOVERNMENT, INDUSTRY, AND FLEETS
Minimize Energy Requirements for HVAC (Cab Insulation)	• Industry groups to set standards (Technology and Maintenance Council, Society of Automotive Engineers, etc.) • Improve insulation technologies: Glass (IR/Thermo), walls (behind), floor, ceiling, space/air volume, curtains/fabrics, soft trim/panels • Reduce energy needs of APU through: Better insulation Alternative power sources (solar, thermo battery, fuel cell) • Investigate new methods and insulation products to minimize added weight • Evaluate cost/benefit for overall system reduction		Government: • Energy credits for improved 'R' value Industry: • Set standards Fleet: • Recognize improved insulation benefits
Maintenance Costs	• Battery-powered (battery pack) HVAC • Modular design HVAC Idle only Road & idle • Integrated with on-road HVAC but APU is separate • Same fuel, lubricant, coolant, and exhaust system used by truck engine and APU • No belts	• Life cycle study (6-12 months)	Government: • Cost-share from DOE Industry: • Cooperation from truck OEMs Fleet: • Cooperation from fleet

HIGH PRIORITY TECHNICAL STRATEGY TO ENCOURAGE DEPLOYMENT BY REDUCING COSTS	METHODS TO ADDRESS KEY ISSUES AND BARRIERS	MILESTONES	ROLES OF GOVERNMENT, INDUSTRY, AND FLEETS
	• On-board diagnostic/prognostic system		
Ease of Aftermarket Installation and Removal	• Develop recommended practice, i.e. standard tie-in fittings AC, engine coolant, oil, wiring, tubing size	•	DOE and Industry: • Establish a working group (truck OEMs and suppliers, IR technology providers, shore power interests) addressing this issue
OEM System Integration to Drive Costs Down	• Supplier investment in engineering for developing installation and testing • Address high life cycle costs through system integration (minimize redundant hardware), reduced maintenance costs, and maximizing APU resale value	• Meeting 2007, 2010 emissions standards • Enforce no-idle regulations	• Customers need/demand will drive APU deployment • Fleet will design/develop to meet customer demand
Establish Performance, Safety, and Other Standards	• Industry (SAE, TMC, TMA, OOIDA, etc) needs to agree on standards • Industry lobbies regulatory agencies (CSA, UL) for standards	• Industry should take no more than 2 years to agree on standards • Regulatory agency will need 1 year to formalize standard	Government: • Fund regulatory standard (DOT?, DOE?, EPA?) Industry: • Agree on and set standards Fleet: • Feed regulations to industry associations

EXHIBIT B-7. POTENTIAL POLICY STRATEGIES TO ENCOURAGE IR TECHNOLOGY DEPLOYMENT BY REDUCING COSTS

◆ = MOST CRITICAL DATA TYPE

LEGISLATION AND REGULATION -CONSTRUCTION AND INSTALLATION	LEGISLATION AND REGULATION -USAGE	INCENTIVES -USAGE	INCENTIVES -EQUIPMENT	ENFORCEMENT
• Timely uniform, appropriate, and sensible regulations ◆◆◆◆◆◆ • New EPA standard for emissions while trucks are idling for overnight stay >4 hours (for all class 7-8 trucks with sleeper). Truck idle emission standard. ◆◆◆◆ • EPA certification of IR technologies ◆◆◆◆ • Environmental and health requirements for implementation of technologies◆ • Increase vehicle weight limits to offset weight of technology • Will APU be legal in all areas	• Identify and implement a prudent stop-idling technology policy for vehicles parked and not occupied, and commonly across jurisdictions ◆◆◆◆◆◆ • Have the govt. equip their vehicles ◆◆◆◆ • Timely uniform, appropriate, and sensible regulations (don't follow CA) ◆ • All publicly funded rest areas on interstate should be required to have shore power hookup • Develop guidelines for "acceptable" idle times based on emissions reductions/fuel usage • Encourage incentives for ambient temperature sensors	• Fuel or energy credit for fleets actually using recognized IR technology ◆◆◆◆◆◆◆◆ • Exception from fuel excise tax for fuel used by IR device [State & Federal] (cost of fuel is a significant factor in savings	• Tax incentives for IR technology equipped trucks that don't idle main engine overnight ◆◆◆◆◆◆ • Tax credits, rebates, and exemptions; matching funds; low cost loans ◆◆◆◆ • Eliminate the Federal excise tax-12% is a major cost driver ◆◆◆ • Rebate program for end-users ◆◆◆ • Fleets and carriers to have access to low cost capital for energy/fuel improvement projects ◆ • Govt. to pay 50% of the cost to purchase IR device for first 2 years of introduction	• Enforce existing and future anti-idling laws ◆◆◆◆◆◆◆◆◆◆ • Stop all fines until evaluation is complete, set a deadline for installation of every truck, then enforce.

EXHIBIT B-8. KEY ISSUES/BARRIERS TO IMPLEMENTING HIGH PRIORITY POLICY STRATEGIES

TAX INCENTIVES FOR HAVING TRUCKS WITH TECHNOLOGY FOR NOT IDLING MAIN ENGINE OVERNIGHT	FUEL OR ENERGY CREDIT FOR FLEETS ACTUALLY USING RECOGNIZED IR TECHNOLOGIES	ENFORCE EXISTING AND FUTURE ANTI-IDLING LAWS	TIMELY UNIFORM, APPROPRIATE, AND SENSIBLE REGULATIONS
• Budget considerations (governmental incentives) are more long term • Tax incentives-who or how are qualifying systems determined • Restrictions on agencies, e.g. difficult to propose incentives that impact federal budget/deficit • Tax incentive for purchase-enforcing that systems were installed/functional	• Use of on-board diagnostics for enforcement • The fuel credit is very difficult to track usage; must be tamper proof	• Internally enforcing policies • Other objectives conflict with anti-idling initiatives (health and safety) • Industry education and awareness of existing technologies • Cooperation of local and/or federal agencies • Use of on-board diagnostics for enforcement	• Alternative regulations raise cost of trucks so no funds are available for IR • What agency is responsible? -States don't always work together • Easy to say hard to write • The government is not a single entity • Business will resist government regulations unless they see financial benefits

EXHIBIT B-9. PRELIMINARY ACTION PLANS FOR ADDRESSING KEY POLICY COST REDUCTION STRATEGIES

HIGH PRIORITY POLICY STRATEGY TO ENCOURAGE DEPLOYMENT BY REDUCING COSTS	METHODS TO ADDRESS KEY ISSUES AND BARRIERS	MILESTONES	ROLES OF GOVERNMENT, INDUSTRY, AND FLEETS
TAX INCENTIVES FOR HAVING TRUCKS WITH TECHNOLOGY FOR NOT IDLING MAIN ENGINE OVERNIGHT	Federal: • ATA must lobby • Secure champion from administration and Congress • Set agenda to match Federal budget process • Pull key Federal agencies together to lend support to program • Target budget areas to place funds • Develop industry team to implement State: • Target industry friendly states • Target states with high traffic • Develop team to approach and confirm potential states • Implement	• By ____, develop team to plan and program budgeting process • By ____, have federal champions selected and confirmed at Congress and key agencies • By ____, draft recommended legislation (budget) (All these items are on an immediate agenda <2 yrs)	Government: • Congress-action proposed Agencies: • Guide and support industry efforts Industry: • Lead efforts to get recommended plans and budget to U.S. Congress and then state legislatures
TIMELY UNIFORM, APPROPRIATE, AND SENSIBLE REGULATIONS	• Determine various agency roles	• By Q4 2003, Roles and leadership determined	• DOE, EPA, DOT, State Agencies
	• DOE takes lead in education process	• By Q1 2005, Preliminary education program complete	• DOE, industry, fleets
	• IR regulations in place	• By 2007, regulations in place	• Everyone
ENFORCE EXISTING AND FUTURE ANTI-IDLING LAWS	• Government funded education program • Proficiently written laws	• Figure out who • Establish who is doing what, and where to start • Optional-2007 Model year sleeper cab trucks must have IRT	• Government must stay current on technology • Fleets to periodically review laws

HIGH PRIORITY POLICY STRATEGY TO ENCOURAGE DEPLOYMENT BY REDUCING COSTS	METHODS TO ADDRESS KEY ISSUES AND BARRIERS	MILESTONES	ROLES OF GOVERNMENT, INDUSTRY, AND FLEETS
FUEL OR ENERGY CREDIT FOR FLEETS ACTUALLY USING RECOGNIZED IR TECHNOLOGIES	• Legislate • Implement - Develop technology to account for idling reduction and to audit fuel savings (must be transparent and idiot proof) • Explore quantification of tax credit for fuel conservation	• 4 years to legislate • 2 years after legislation to implement	Industry: • lobby • implement Government (federal/states): • pass rules/laws Fleets: • lobby